SNOW SAMPLING SURVEY
in the vicinity of
GREAT LAKES FOREST PRODUCTS LIMITED
THUNDER BAY

February, 1982

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INTRODUCTION

A Ministry of the Environment study in February, 1978, revealed that calcium, sodium, sulphate and pH were significantly elevated in snow sampled near the Great Lakes Forest Products Limited kraft pulp mill in Thunder Bay (1). The presence of brown and black particulate matter (sawdust and bark char) was also noted in snow at some sampling sites on or close to company property.

In November, 1981, Great Lakes converted three of its four power boilers from natural gas to coal. As a result, visible emissions from the power boiler stack increased, leading to concerns about a possible increase in fallout of particulate matter. To document the effects of this change in boiler operating procedures, a snow sampling survey was carried out in the same area studied in 1978.

METHODS

Duplicate samples of snow were collected on Februay 16, 1982 from 25 sites near the kraft mill (Figure 1) and from two control locations remote from the study area. Core samples of the complete snow profile were obtained following standard Ministry sampling procedures (2). Snow meltwater samples were submitted to the Ministry's Thunder Bay laboratory for analysis of aluminum, calcium, chloride, sodium, nickel and sulphate, and determination of conductivity, suspended solids and pH. Calcium, chloride, sodium and sulphate compounds are commonly emitted from kraft pulp mills. Aluminum and nickel were selected as possible tracers of power boiler fly ash. Analysis of carbon, a potential tracer for wood fines, unburned coal or bark, was performed at the Ministry's Toronto laboratory. In addition to the foregoing chemical analyses, meltwater filtrate was examined at the Thunder Bay laboratory. The approximate volume percentages of substances

visually identified by microscopic examination were determined, then converted to weight (mg/ℓ) by applying an appropriate density factor. The total particulate matter comprising meltwater filtrate was considered approximately equivalent to total suspended solids in the sample.

RESULTS AND DISCUSSION

Results from the 1982 survey are summarized in Tables 1 to 3. Concentrations of calcium, chloride, sodium and sulphate were slightly elevated near the kraft mill and decreased with increasing distance from company property. The highest levels of calcium, sodium and sulphate were found at site 5 on company property near the kraft mill lime kiln. The unusually high readings for sodium and chloride recorded at site 31 were attributed to a source (possibly road salt) other than mill emissions. The generally lower levels of calcium, chloride, sodium, sulphate, conductivity, suspended solids and pH in 1982 compared to 1978 suggest that contaminant emissions from the kraft mill had decreased since the 1978 survey. There was also a sharp decline in suspended solids at sites 1 and 2, near the waferboard plant. This decrease may have resulted partly from reduced emissions and partly from production shutdown periods between late December, 1981 and the survey date in February.

Aluminum and nickel did not prove to be satisfactory as tracers for fly ash. Concentrations of both these elements were uniformly low throughout the study area (Table 2). In contrast, total particulate carbon (Table 2) showed a deposition pattern (Figure 2) characteristic of most contaminants we have examined in past snow surveys around Great Lakes. Particulate carbon is considered to be a tracer for substances such as wood fibres and unburned coal or bark.

Table 3 shows the breakdown of components of suspended solids. These data indicate that fly ash and wood fibre accounted for virtually all the suspended solids in snow meltwater.

Figures 3 and 4 show the distribution of wood fibres and fly ash, respectively, around Great Lakes. Although these distribution patterns point to Great Lakes as the source, the suspended solids data in Table 1 suggests that there has been no overall increase in these substances from 1978 to 1982.

Trace to heavy quantities of wood fines and charred material were noted in snow or snow meltwater at all sites except sites 4, 33, 35 and control locations. The quantities of these contaminants were distributed in a pattern generally similar to that shown in Figure 2 for total particulate carbon.

CONCLUSIONS

The 1982 snow survey at Great Lakes demonstrated that while this forest products complex continued to be a source of airborne calcium, sodium and sulphur compounds, their concentrations had declined from the date of the previous survey in 1978. Deposition of wood fines also decreased sharply over the same period at sites near the waferboard plant.

Fly ash and unburned coal or bark particles were found to be deposited in the snow around Great Lakes. Failure of the data to show an increase in fallout of this material in 1982, compared to 1978, may be due to differences in snowpack features during the two surveys. Variation in snow depth, age of snow, and occurrence of thaws may significantly affect contaminant levels in meltwater from snow samples.

Power boiler emissions should be significantly reduced by September, 1981, when fabric bag collectors are to be installed to remove particulate matter from the two coal-fired power boilers now operating without emission controls. A snow sampling survey to assess improvements achieved by this action will be carried out after that date.

REFERENCES

1. Griffin, H. D. and D. J. Racette. 1978. Snow sampling survey, Great Lakes Paper Limited, Thunder Bay. February, 1978. Ontario Ministry of the Environment.

2. Ontario Ministry of the Environment. 1982. Field investigation procedures manual. Phytotoxicology Section, Air Resources Branch.

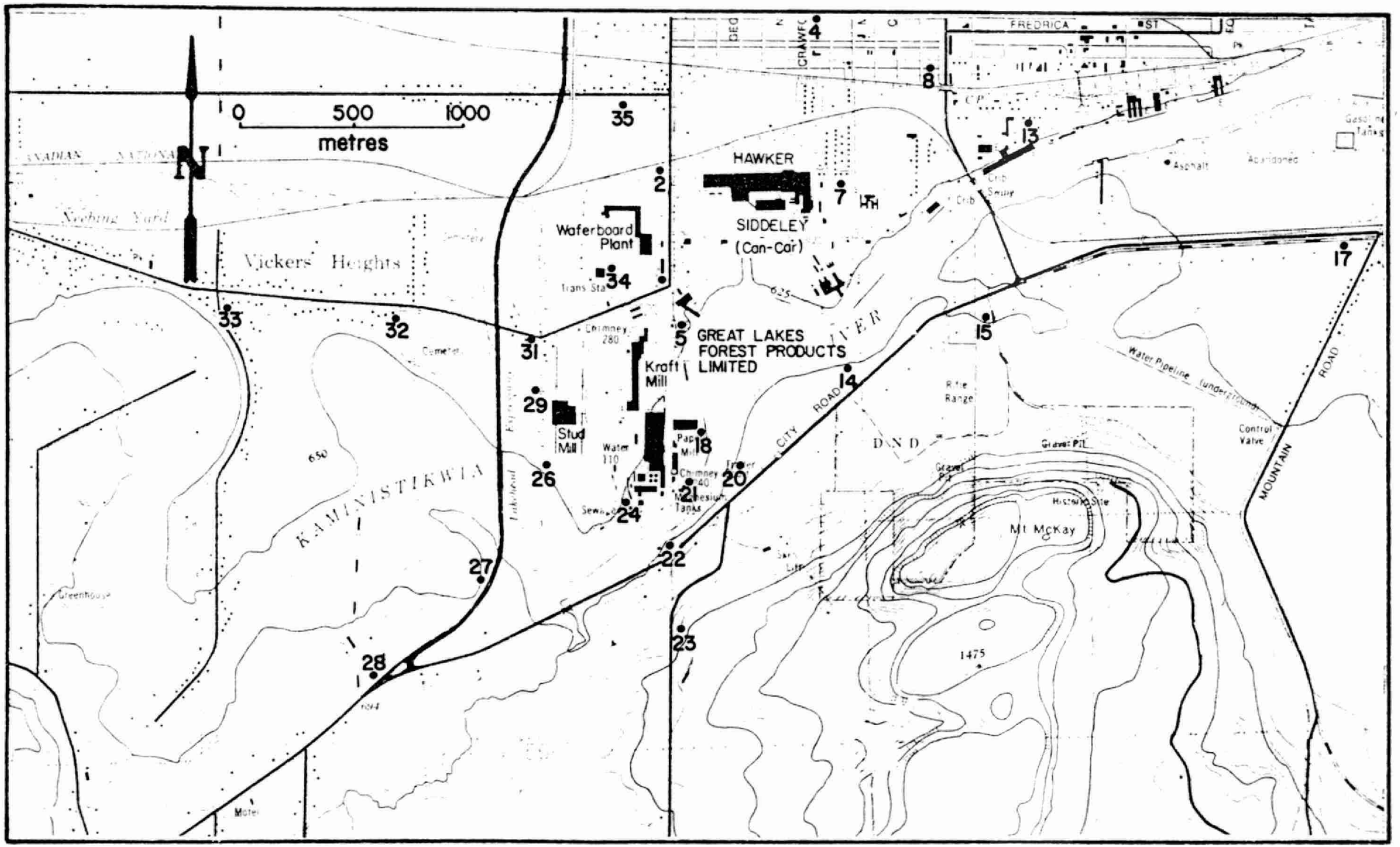

Figure I. Snow sampling sites, Thunder Bay, February, 1982.

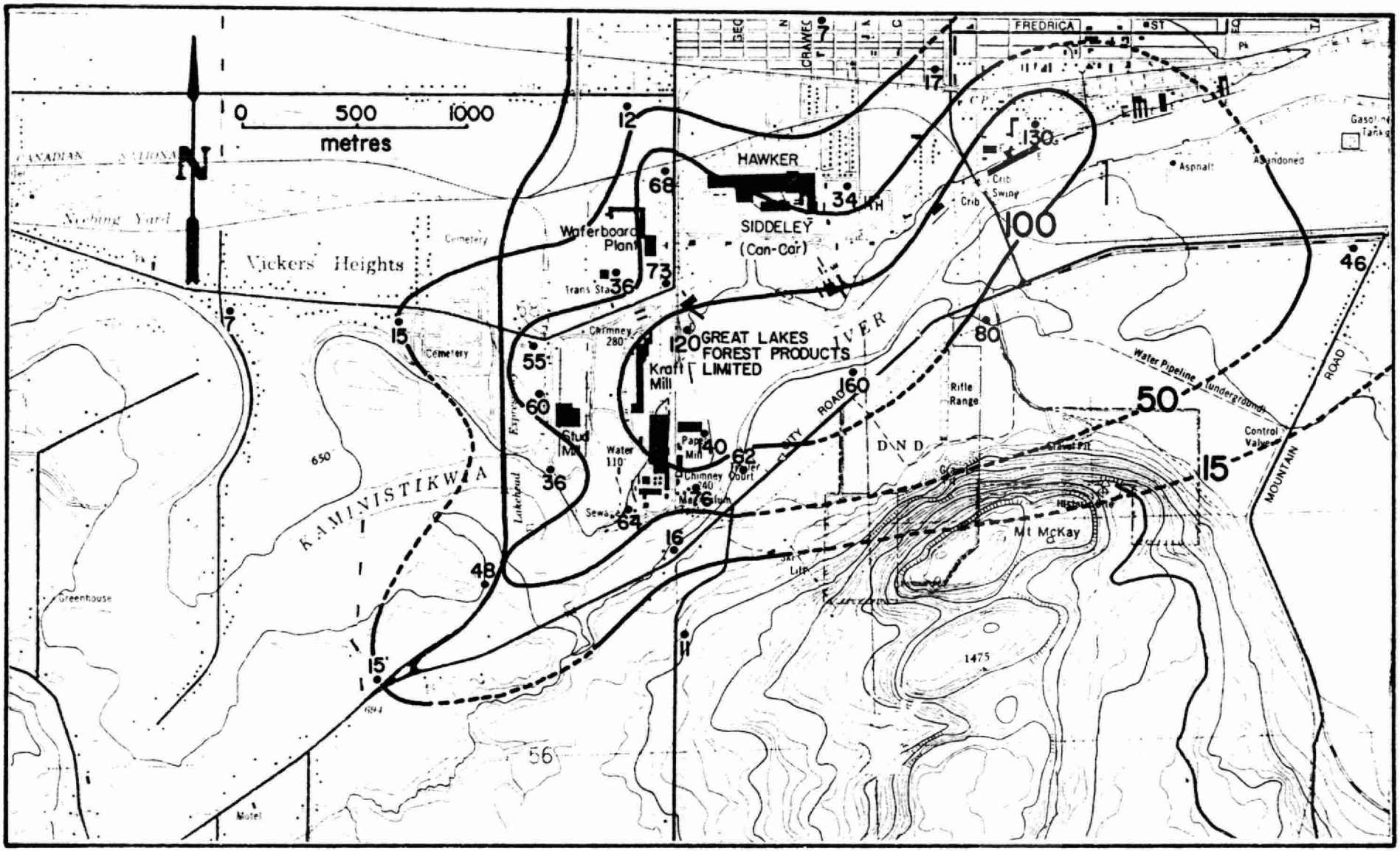

Figure 2. Levels of total particulate carbon (mg/l) in snow meltwater, Thunder Bay, February, 1982.

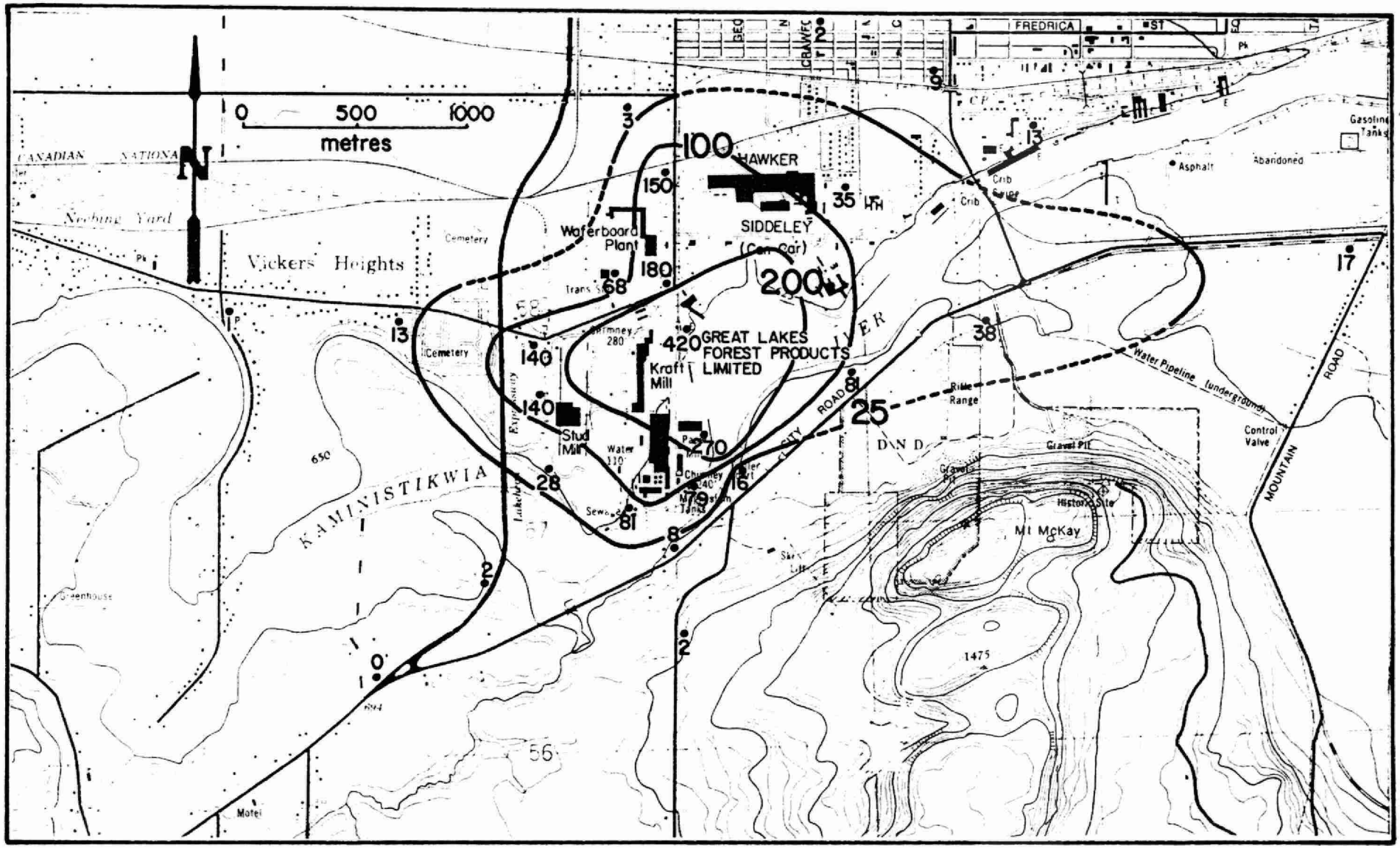

Figure 3. Levels of wood fibre (mg/l) in snow meltwater, Thunder Bay, February, 1982.

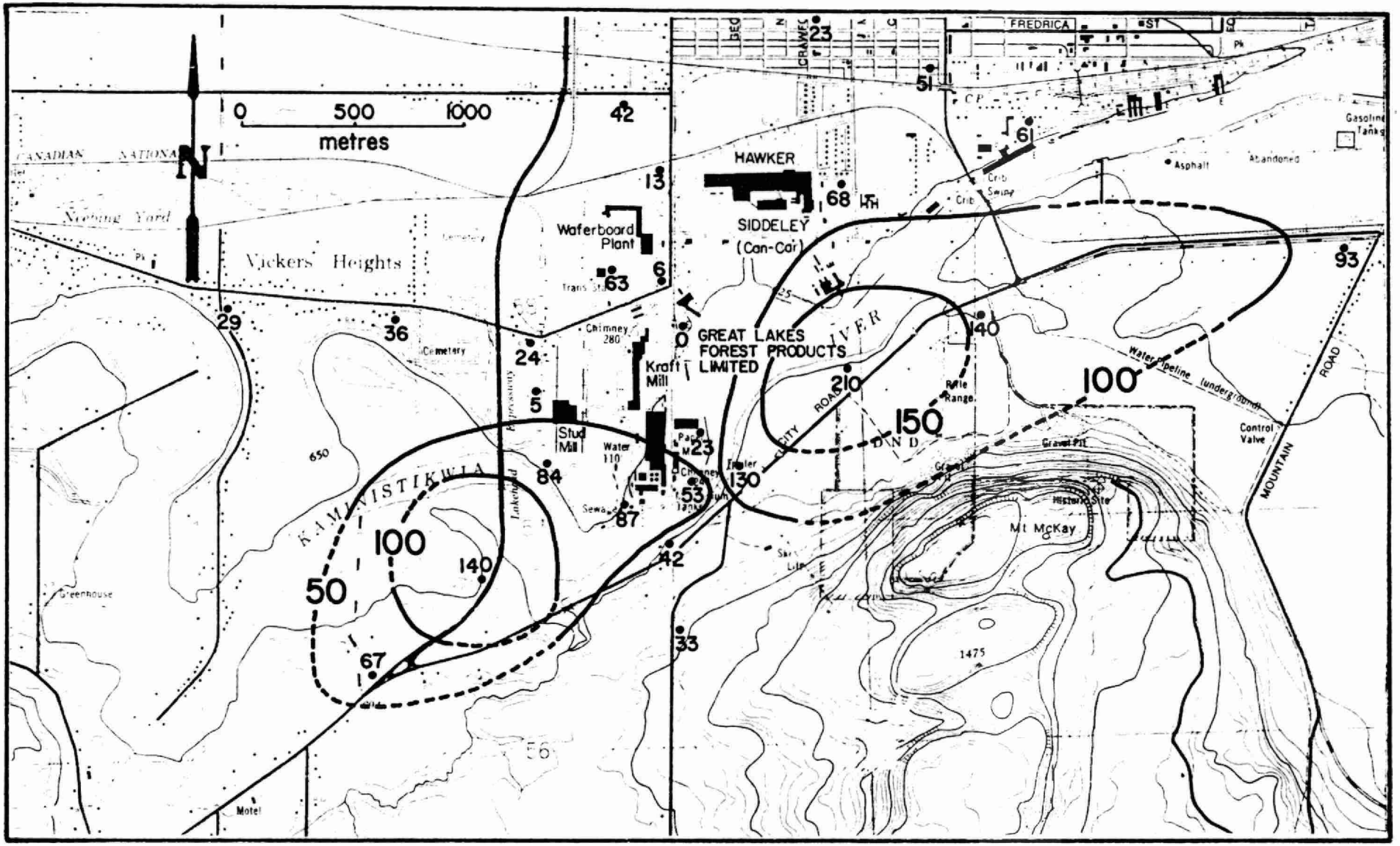

Figure 4. Levels of fly ash (mg/l) in snow meltwater, Thunder Bay, February, 1982.

TABLE 1. Comparison between levels of calcium, chloride, sodium, sulphate, suspended solids (mg/ℓ), conductivity μmhos/cm and pH in snow collected in the vicinity of Great Lakes Forest Products Limited, Thunder Bay on February 13-14, 1978, and February 16, 1982.

Site	Calcium		Chloride		Sodium		Sulphate		Conductivity		Suspended solids		pH	
	1978	1982	1978	1982	1978	1982	1978	1982	1978	1982	1978	1982	1978	1982
1	6	4	6	5	10	5	21	8	100	54	620	180	5.8	6.5
2	6	2	5	17	7	12	12	5	95	82	3600	160	5.6	6.1
4	2	<1	2	2	1	2	3	2	20	18	20	25	7.5	5.3
5	-	48	-	7	-	24	-	22	-	330	-	420	-	10.7
7	14	9	4	4	7	3	15	5	110	88	170	100	10.2	10.0
8	6	3	4	11	4	7	8	3	65	62	100	60	8.2	7.3
13	12	6	4	2	9	2	21	3	120	47	230	74	10.1	9.4
14	10	7	5	2	9	2	24	7	120	62	300	290	9.8	9.5
15	-	6	-	2	-	3	-	7	-	50	-	180	-	9.1
17	10	4	6	2	7	2	16	5	100	35	280	110	9.8	8.0
18	-	6	-	3	-	2	-	7	-	57	-	290	-	9.2
20	10	4	3	2	7	2	20	7	100	36	160	150	9.2	7.3
21	-	6	-	2	-	2	-	7	-	44	-	150	-	7.8
22	6	1	3	3	6	2	14	4	77	26	110	50	9.0	6.2
23	3	<1	2	1	4	<1	9	2	43	16	58	35	8.4	5.4
24	-	4	-	3	-	2	-	5	-	36	-	170	-	6.8
26	6	2	4	3	9	3	19	5	91	34	98	110	7.2	7.0
27	7	2	5	4	8	3	18	5	91	34	190	150	8.6	6.5
28	6	2	4	2	8	2	18	5	83	30	90	68	9.2	6.2
29	-	8	-	4	-	6	-	9	-	89	-	150	-	9.7
31	3	5	6	26	9	22	14	8	76	140	85	160	7.2	8.2
32	2	1	1	2	2	2	6	5	28	24	28	50	6.9	5.9
33	2	<1	2	1	2	2	4	4	24	20	25	30	7.0	5.9
34	-	4	-	4	-	4	-	6	-	52	-	140	-	8.8
35	2	1	3	6	3	4	4	3	28	34	25	45	6.2	6.1
Controls	1	<1	<1	<1	<1	<1	2	<1	13	11	9	10	5.0	4.4
Normal background	<5		<5		<5		<5							

TABLE 2. Levels of aluminum, carbon and nickel (mg/ℓ) in snow collected in the vicinity of Great Lakes Forest Products, Thunder Bay on February 16,1982

Station	Aluminum	Total particulate carbon	Nickel
1	1.0	73	0.004
2	0.8	68	0.004
4	0.4	7	0.002
5	1.6	120	0.005
7	1.2	34	<0.002
8	0.9	17	0.004
13	1.0	130	0.004
14	1.5	160	<0.002
15	1.2	80	0.002
17	1.3	46	0.003
18	1.1	140	0.002
20	1.4	62	<0.002
21	1.0	76	<0.002
22	0.7	16	<0.002
23	0.5	11	<0.002
24	1.4	64	<0.002
26	1.2	36	<0.002
27	2.2	48	0.003
28	1.2	15	<0.002
29	0.8	60	<0.002
31	1.6	55	<0.004
32	0.7	15	0.002
33	0.6	7	<0.002
34	1.1	36	<0.002
35	0.8	12	0.004
Controls	<0.1	<5	<0.002
Normal background	<1.0	-	-

TABLE 3. Composition of particulate matter (suspended solids) in snow meltwater from samples collected in the vicinity of Great Lakes Forest Products Limited, Thunder Bay, on February 16, 1982.

Station	Fly ash		Wood fibre		Char		Other		Suspended Solids
	mg/ℓ	%	mg/ℓ	%	mg/ℓ	%	mg/ℓ	%	mg/ℓ
1	6	2	180	98	0	0	0	0	180
2	13	5	150	95	0	0	0	0	160
4	23	90	2	10	0	0	0	0	25
5	0	0	420	100	0	0	0	0	420
7	68	55	35	45	0	0	0	0	100
8	51	77	9	23	0	0	0	0	60
13	61	75	13	25	0	0	0	0	74
14	210	62	81	38	0	0	0	0	290
15	140	70	38	30	0	0	0	0	180
17	93	77	17	23	0	0	0	0	110
18	23	5	270	95	0	0	0	0	290
20	130	75	16	15	8	10	0	0	150
21	53	25	79	60	16	15	0	0	150
22	42	78	8	22	0	0	0	0	50
23	33	90	2	10	0	0	0	0	35
24	87	40	81	60	0	0	0	0	170
26	84	65	28	35	0	0	0	0	110
27	140	90	2	2	6	8	0	0	150
28	67	98	0	0	0	0	1	2	68
29	5	2	140	98	0	0	0	0	150
31	24	10	140	90	0	0	0	0	160
32	36	60	13	35	2	5	0	0	50
33	29	95	1	5	0	0	0	0	30
34	63	35	68	60	4	5	0	0	140
35	42	90	3	10	0	0	0	0	45
Controls	10	98	0	0	0	0	0	2	10

DATE	ISSUED TO
	S. Stanley
Jan. 12	D. Walmsley.